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10/554,136	05/12/2006	Hiroshi Kawazoe	3836.001	9371

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EXAMINER	
HSIEH, HSIN YI	

ART UNIT	PAPER NUMBER
2811	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/554,136	KAWAZOE ET AL.	
	Examiner	Art Unit	
	Hsin-Yi (Steven) Hsieh	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 April 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-9,12-20,22 and 23* is/are pending in the application.

4a) Of the above claim(s) *20 and 23* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-9,12-19 and 22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *16 April 2010* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Newly submitted claims 20 and 23 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: Claims 20 and 23 introduced new materials of the n-electrode and p-electrode which is distinctly different from the materials selected from the original selected materials (ZnSe, ZnS, or ZnTe of claim 15).

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 22 and 23 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Specification

2. The amendment filed 04/16/2010 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: the amendment of replacing "the conduction band edge" with "the valence band edge" in the paragraph at pages 23, line 24 to page 24, line 6.

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Objections

3. Claim 6 is objected to because of the following informalities:

4. Claim 6 recites "comprising comprising" in the third and fourth lines of the claim, which seems to be a typo of "comprising."

5. Claim 21 is missing in the amendment of claims filed 04/16/2010.

6. Appropriate correction is required.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

8. **Claims 16 and 18-19** are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

9. Claim 16 recites "the ambipolar light-emitting layer includes no quantum well and associated barriers" which lacks the support in the original disclosure. The original disclosure does not discuss the quantum well at all.

10. Claim 18 recites "the p-electrode has a work function higher than a valence band edge energy of the inorganic semiconductor material" in the last two lines of the claim which is different form what is disclosed in the original disclosure: "the work function of the p-electrode is higher than the conduction band edge energy of the ambipolar inorganic semiconductor" as disclosed in the first two lines of page 24.

11. Claim 19 is rejected because they depend on the rejected claim 18.

12. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

13. **Claims 18-19** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

14. Claim 18 recites "a conduction band edge energy" in the 11th line of the claim, while a reference energy level is not defined. The energy level of the conduction band edge is only meaningful when a reference energy level, i.e. 0 energy level is defined. Without defining the reference energy level, the conduction band edge energy is ambiguous. Applicant is advised to specify the reference energy level or use a term that already has the reference level defined, e.g. electron affinity.

15. Claim 19 is rejected because they depend on the rejected claim 18.

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

18. **Claims 1-2, 4-9, 12-19, and 22** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawazu et al. (US 5,539,239 A) as can be understood since claims 16 and 18-19 have been rejected under 35 U.S.C. 112.

19. Regarding **claim 1**, Kawazu et al. teach a light-emitting diode (semiconductor light emitting element; Abstract) characterized by comprising: an electron injecting electrode, that is, an n-electrode (n type ZnSe cladding layer 5; Fig. 1, col. 7 lines 13-14); a hole injecting electrode, that is, a p-electrode (p type ZnSe cladding layer 3; Fig. 1, col. 7 line 8); and an inorganic light-emitting layer (undoped ZnSe active layer 4; Fig. 1, col. 7 lines 11-12) wherein the inorganic light-emitting layer (4) (1) is formed of an inorganic semiconductor material (undoped ZnSe; col. 7 lines 11-12) having an ambipolar property in which the ratio of respective mobilities of electrons and holes is in a range of 1/10 to 10 (undoped ZnSe has this property), (2) is disposed between the n-electrode (5) and the p-electrode (3) so as to respectively contact the n-electrode and the p-electrode (5 and 3) in a non-barrier junction manner (5, 4, 3 form a p-i-n diode which is considered in a non-barrier junction manner as the diode conducts in the forward biased condition) such that the inorganic semiconductor material (undoped ZnSe) conducts both electrons injected from the n-electrode (5) and holes injected from the p-electrode (3; conducting both electrons and holes is an intrinsic property of undoped ZnSe), wherein the inorganic light-emitting layer (4) emits light resulting from electrons injected from the n-electrode (5) and holes injected from the p-electrode (3) recombining between the two electrodes (5 and 3; the light

emitting is a intrinsic property of this PIN diode), and wherein the inorganic semiconductor material having the ambipolar property (undoped ZnSe) is selected from the group consisting of (a) a group II-VI compound and (b) Zn and at least one element selected from the group consisting of S, Se and Te (i.e. Zn and Se).

Kawazu et al. do not teach the inorganic light-emitting layer (3) has a thickness in a range of 100 nm or more and 10 μm or less, while teach a thickness of 10 nm (col. 7 lines 11-12) which is close to the claimed range.

Furthermore parameters such as the thickness of the inorganic light-emitting layer in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication. Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to incorporate the thickness of the inorganic light-emitting layer within the range as claimed in order to form a high quality film.

20. Regarding **claim 2**, Kawazu et al. also teach the light-emitting diode according to claim 1, characterized in that the inorganic light-emitting layer (4) consists of a semiconducting material (undoped ZnSe) having a dopant concentration of 0.1% or less in atomic ratio (zero as it is undoped).

21. Regarding **claim 4**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that the n-electrode (5) includes a layer (5) comprising an n-type dopant (Cl; col. 7 line 15) and the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 lines 13-14).

22. Regarding **claim 5**, Kawazu et al. also teach the light-emitting diode according to any claims 1 or 2, characterized in that the p-electrode (3) includes a layer (3) comprising a p-type dopant (N; col. 7 line 10) and the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 line 8).

23. Regarding **claim 6**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that the n-electrode (5) includes a first layer (5) comprising comprising an n-type dopant (Cl; col. 7 line 15) and the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 lines 13-14), and the p-electrode (3) includes a second layer (3) comprising a p-type dopant (N; col. 7 line 10) and the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 line 8).

24. Regarding **claim 7**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that a material (ZnSe) of a portion contacting the light-emitting layer (4) in at least one of the n-electrode (5) and the p-electrode (3) is formed by use of a material (ZnSe) substantially different from the material of the light-emitting layer (CdZnSe of the CdZnSe-ZnSe multi-quantum well layer 21; Fig. 6, col. 2 lines 42-43)

25. Regarding **claim 8**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that the inorganic semiconductor material having the ambipolar property (4) is formed on a crystalline substrate or a glass substrate (GaAs substrate 1; Fig. 1, col. 7 line 4), and the n-electrode (5) and the p-electrode (3) are formed on opposing sides of the inorganic semiconductor material having the ambipolar property (4), wherein the n-electrode (5) and the p-electrode (3) do not contact each other (see Fig. 1).

26. Regarding **claim 9**, Kawazu et al. also teach the light-emitting diode according to claims 1 or 2, characterized in that a first one of the n-electrode (5) and the p-electrode (3) is formed on a crystalline substrate or a glass substrate (GaAs substrate 1; Fig. 1, col. 7 line 4), and the inorganic semiconductor material having the ambipolar property (4) is stacked thereon (4 is stacked on 1), and a second one of the p-electrode (5) and the n-electrode (3) is stacked thereon (5 and 3 are stacked on 1).

27. Regarding **claim 12**, Kawazu et al. also teach the light emitting diode according to claim 1, wherein only one such light-emitting layer (4) is formed between the p-electrode (3) and the n-electrode (5).

28. Regarding **claim 13**, Kawazu et al. also teach a light-emitting diode (semiconductor light emitting element; Abstract), comprising: an electron injecting n-electrode (n type ZnSe cladding layer 5; Fig. 1, col. 7 lines 13-14); a hole injecting p-electrode (p type ZnSe cladding layer 3; Fig. 1, col. 7 line 8); an ambipolar light-emitting layer (undoped ZnSe active layer 4; Fig. 1, col. 7 lines 11-12) (1) continuously extending from the n-electrode (5) to the p- electrode (3; see Fig. 1), (2) consisting of an ambipolar semiconducting material (undoped ZnSe, an ambipolar material which can transport electrons and holes; col. 7 lines 11-12) which conducts both electrons injected by the n-electrode (5) and holes injected by the p-electrode (3; conducting both electrons and holes is an intrinsic property of undoped ZnSe), and (4) comprising a first semiconductor material (ZnSe) selected form the group consisting of (a) a group II-VI compound and (b) Zn and at least one element selected from the group consisting of S, Se and Te (i.e. ZnSe).

Kawazu et al. do not teach an inorganic light-emitting layer (3) having a thickness in a range of equal to or greater than 100 nm and no more than 10 μm, while teach a thickness of 10 nm (col. 7 lines 11-12) which is close to the claimed range.

Furthermore parameters such as the thickness of the inorganic light-emitting layer in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication. Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to incorporate the thickness of the inorganic light-emitting layer within the range as claimed in order to form a high quality film.

29. Regarding **claim 14**, Kawazu et al. also teach the light-emitting diode of claim 13, wherein the ambipolar light-emitting layer (4) consists of the first semiconductor material (ZnSe; col. 7 lines 11-12).

30. Regarding **claim 15**, Kawazu et al. also teach the light-emitting diode of claim 13, wherein the first semiconductor material (ZnSe) is Zn and at least one element selected from the group consisting of S, Se and Te (i.e. Se).

31. Regarding **claim 16**, Kawazu et al. also teach the light-emitting diode of claim 13, wherein the ambipolar light-emitting layer (4) includes no quantum well and associated barriers (col. 7 lines 11-12).

32. Regarding **claim 17**, Kawazu et al. also teach the light-emitting diode according to claim 1, wherein the light-emitting layer (4) consists essentially of the inorganic semiconductor material having the ambipolar property (ZnSe; col. 7 lines 11-12).

33. Regarding **claim 18**, Kawazu et al. teach a light-emitting diode (semiconductor light emitting element; Abstract) characterized by comprising: an electron injecting electrode, that is, an n-electrode (n type ZnSe cladding layer 5; Fig. 1, col. 7 lines 13-14); a hole injecting electrode, that is, a p-electrode (p type ZnSe cladding layer 3; Fig. 1, col. 7 line 8); and an inorganic light-emitting layer (undoped ZnSe active layer 4; Fig. 1, col. 7 lines 11-12), wherein the light-emitting layer (4) is disposed between the n-electrode (5) and the p-electrode (3) so as to respectively contact the n-electrode (5) and the p-electrode (3; see Fig. 1) and is formed of an inorganic semiconductor material having an ambipolar property (ZnSe) in which the ratio of respective mobilities of electrons and holes is in a range of 1/10 to 10 (ZnSe has this property), wherein the inorganic light-emitting layer (4) emits light resulting from electrons injected from the n-electrode (5) and holes injected from the p-electrode (3) recombining between the two electrodes(5 and 3; the light emitting is a intrinsic property of this PIN diode), wherein the inorganic semiconductor material having the ambipolar property (ZnSe) is selected from the group consisting of (a) a group II-VI compound and (b) Zn and at least one element selected from the group consisting of S, Se and Te (i.e. Zn and Se), wherein the n-electrode (n type ZnSe) has a work function lower than a conduction band edge energy of the inorganic semiconductor material having the ambipolar property (undoped ZnSe), and wherein the p-electrode (p type ZnSe) has a work function higher than a valence band edge energy of the inorganic semiconductor material having the ambipolar property (undoped ZnSe; this relationship of work functions, the conduction band edge energy, and the valence band edge energy is intrinsically satisfied as the three layer structure of p-ZnSe/undoped_ZnSe/n-ZnSe with undoped ZnSe as the

active layer is exactly the same as the examples shown in the second paragraph of page 25 of the instant application).

Kawazu et al. do not teach an inorganic light-emitting layer has a thickness in a range of 100 nm or more and 10 μm or less, while teach a thickness of 10 nm (col. 7 lines 11-12) which is close to the claimed range.

Furthermore parameters such as the thickness of the inorganic light-emitting layer in the art of semiconductor manufacturing process are subject to routine experimentation and optimization to achieve the desired film quality during device fabrication. Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to incorporate the thickness of the inorganic light-emitting layer within the range as claimed in order to form a high quality film.

34. Regarding **claim 19**, Kawazu et al. also teach the light-emitting diode of claim 18, wherein the inorganic light-emitting layer (4) contacts the n-electrode (5) without forming a barrier therebetween (the intrinsic property of n type ZnSe and undoped ZnSe) and the inorganic light-emitting layer (4) contacts the p-electrode (3) without forming a barrier therebetween (the intrinsic property of p type ZnSe and undoped ZnSe).

35. Regarding **claim 22**, Kawazu et al. also teach the light-emitting diode of claim 1, wherein the inorganic light-emitting layer (4) contacts the n-electrode (5) without forming a barrier therebetween (the intrinsic property of n type ZnSe and undoped ZnSe) and the inorganic light-emitting layer (4) contacts the p-electrode (3) without forming a barrier therebetween (the intrinsic property of p type ZnSe and undoped ZnSe).

Response to Arguments

36. Applicant's amendments, filed 04/16/2010, overcome the objections to drawings and the rejections to claims 1-2, 4-9, 11-15 and 17 under 35 U.S.C. 112. The objections to drawings and the rejections to claims 1-2, 4-9, 11-15 and 17 under 35 U.S.C. 112 have been withdrawn. The rejections to claims 16 and 18 under 35 U.S.C. 112 still stand.

37. Regarding to the rejections to claim 16 under 35 U.S.C. 112, the applicant argues that the exclusion of a quantum well structure is inherent in the filed applicant based on that a semiconductor quantum well requires a thickness much less than 100 nm. The examiner respectively disagrees. The thickness limitation of a device depends on the maturity of the technology which is not a good way to exclude some devices. The most important thing is that the original disclosure does not mention the quantum well at all. Selecting only quantum wells to be excluded from the claim just does not have a solid support from the original disclosure.

38. Regarding to the rejections to claim 18 under 35 U.S.C. 112, the applicant argues that the band edge energy and the two work functions are all measured from a common reference energy, typically Fermi energy. The examiner respectfully disagrees. The work functions are defined not to depend on the common reference potential while the value of the band edge energy depends on the common reference energy. The applicant is advised to clearly specify the common reference energy in the claim to avoid the ambiguity.

39. Applicant's arguments with respect to claims 1-2, 4-9, and 11-18 have been considered but are moot in view of the new ground(s) of rejection.

40. On pages 12-16 of Applicant's Response, Applicant argues that Kawazu is based on quantum well and Kawazu's quantum well structure does not have the claimed ambipolarity.

41. The Examiner respectfully disagrees with Applicant's argument, because Kawazu teaches a single undoped ZnSe active layer in the embodiment of Fig. 1 (col. 7 lines 10-12) and the layer is not a quantum well.

Conclusion

42. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsin-Yi (Steven) Hsieh whose telephone number is 571-270-3043. The examiner can normally be reached on Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne A. Gurley can be reached on 571-272-1670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Lynne A. Gurley/
Supervisory Patent Examiner, Art Unit 2811

/H. H./
Examiner, Art Unit 2811
7/3/2010